

PORTLAND HARBOR RI/FS

APPENDIX O

CONSIDERATIONS FOR DREDGE RELEASES

FEASIBILITY STUDY

June 2016

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Table O-1 Feasibility Study Considerations for Dredge Releases

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01. DREDGE RELEASE CONSIDERATIONS

Contaminant releases from dredging can exist as one of three phases (Palermo et al. 2008): volatile gases, dissolved contaminants, or particulate-bound contaminants. Volatile gas releases are contaminants that transfer from the sediments or pore water to the water column and finally to the atmosphere. Dissolved contaminant releases can originate as contaminated pore water released from disturbed sediments or as contaminants partitioning from sediments into the water column. These dissolved contaminant releases are particularly susceptible to downstream transport and are generally more bioavailable than particulate-bound contaminants. Particulate-bound releases are contaminated sediments that are suspended into the water column during dredging operations. These particles can either settle back within/adjacent to the dredge prism or be transported downstream in varying quantities, depending on the particle size, hydrodynamic forces of the water body, use of dredging best management practices, and other factors. Particulate-bound contaminants can also partition into the aqueous phase and become dissolved contaminant releases. This appendix provides FS considerations for release of dissolved and particulate-bound contaminants to the water column.

01.1 CONSIDERATIONS FOR EVALUATING DREDGE RELEASES

Models to estimate contaminant release can be used during the design phase of a sediment remediation project. However, using these contaminant release models is resource intensive and they may not appropriately represent the range of conditions present at the site. A qualitative assessment of dredge releases derived from field measurements at other sites was used for as an FS-level approximation for evaluating dredge releases. The major considerations used in this evaluation included:

- The presence of non-aqueous phase liquids (NAPL)
- Mass of contaminant release
- Duration of contaminant release during dredging operations
- Site characteristics affecting control measures, including water depth and water current

01.2 PRESENCE OF NAPL

NAPL in sediment that is disturbed during dredging can result in increased contaminant releases to the water column and exceedances of water quality criteria. Rigid control measures (such as sheet piles) were assumed in areas where NAPL is present in less than 50 feet of water based on the length of commercially available sheet pile walls.

O1.3 MASS OF PARTICULATE-BOUND AND DISSOLVED CONTAMINANT RELEASE

The magnitude of potential releases during dredging operations is governed by several factors, including the following:

- Fraction of sediment re-suspended during dredging operations
- Bulk in situ density of the sediment being dredged
- Volume of sediment dredged
- Contaminant concentration in the dredged sediment
- Contaminant partitioning properties
- Contaminant concentration in the sediment pore water within the dredge prism

Due to a lack of sufficient site-specific data or estimates for these variables, “rules of thumb” derived from field measurements regarding the magnitude of dredge releases at other sites were used during the FS evaluation. Recent field analyses have shown that the mass of contaminant released from dredging operations is typically 1 percent of the total contaminant mass removed, if the dredge residuals are capped soon after dredging and if operational BMPs are followed during dredging operations (Gustavson and Schroeder 2013). For example, Phase 2 operations at the Hudson River (where a residual cap was placed shortly following dredging) showed PCB losses at the compliance monitoring locations that were less than 1 percent of the PCB mass removed (Garvey et al. 2013). This post-dredge capping is typically accomplished with a three to six inch layer of sand applied over the dredge area as soon as practicable following completion of dredging activities. Operational BMPs used to limit releases may include such practices as slower bucket cycle times and the use of environmental buckets. Contaminant releases in the absence of post-dredge thin layer capping and operational BMPs are typically on the order of 2-3 percent of the total contaminant mass removed (Bridges et al. 2010).

Use of BMPs, including steps to avoid excessive reworking of in-situ sediment and dredge water management (see discussion in Section 2) was assumed during dredging. A 12-inch sand residual layer will be placed over the dredge prism to manage residuals after the design elevation is as met in 95 percent of the dredging work area (adapted from Louis Berger Group 2010). Using a 12-inch sand residual layer eliminates the need for additional dredge passes and minimizes mixing of the residual layer with the underlying contaminated sediment layer. As a result, the magnitude of contaminant releases resulting from dredging operations was assumed to be 1 percent of the total contaminant mass dredged.

O1.4 DURATION OF CONTAMINANT RELEASE

Dissolved and particulate-bound releases occur as the sediment bed is dredged and for some period after the dredging has stopped. These releases are associated with

contaminated pore water being released to the water column from the disturbed sediments, contaminated sediments being suspended into the water column, and contaminants partitioning from the newly exposed sediments to the overlying water column. The FS assumed that short term releases occurred from the start of dredging until a 12-inch sand layer was placed over the dredged area.

O1.5 SITE CHARACTERISTICS AFFECTING RELEASE CONTROL MEASURES

Water current and depth can limit the use of suitable engineered options for controlling releases. For example, high water velocities can limit the effectiveness of silt curtains, deep water depths can preclude the use of sheet piles.

As an example of release control measures implemented within Portland Harbor, silt curtains were utilized during the Gasco removal action. The silt curtains were up to 43 feet in depth and a “stop work” condition was instituted in water currents greater than 1 foot per second. Water quality monitoring during these dredging activities indicated that the silt curtains were 72 – 84 percent effective in reducing releases outside the silt curtain containment area (Anchor Environmental 2006).

O4. SUMMARY OF FS CONSIDERATIONS

The Portland Harbor FS evaluations considered the following:

- Contaminant releases during dredging are anticipated. Operational BMPs that have been successfully implemented at other sites were assumed to be implemented wherever and whenever possible to limit releases and prevent exceedances of water quality criteria. Implementation of BMPs is anticipated in addition to the use of engineered control measures.
- Engineered rigid containment was assumed to be utilized when NAPL was present in water depths less than 50 feet.
- The use of silt curtains was assumed for other remedial areas involving capping or dredging activities, with the exception of the navigation channel.
- Dredging was assumed to take place during a fish window of July 1 to October 31.
- A 12-inch thick sand residual layer would be placed promptly after the design dredge elevation was met in greater than or equal to 95 percent of the dredging work area.

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Tables

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Table O-1.
Feasibility Study Considerations for Dredge Releases
 Portland Harbor Superfund Site
 Portland, Oregon

Factor	Technical Consideration	Short Term Effectiveness Implication	Cost Implication	FS Evaluation
Presence of NAPL	NAPL disturbed during remediation activities result in water quality criteria exceedances.	Engineered rigid control measures (e.g., sheet piles) may minimize NAPL releases outside of the sheet pile enclosed work area.	Engineered rigid control measures will increase the cost of remediation activities and will require extensive design considerations.	Engineered rigid control measures were assumed to be incorporated into any remediation alternative involving the presence of NAPL in water depths less than 50 feet.
Mass of Contaminant Releases	<p>Releases totaling 3% of the total dredged contaminant mass have been observed at other sites in the absence of control measures.</p> <p>Releases totaling 1% of the total dredged contaminant mass are assumed to occur when a thin layer of sand is quickly placed over the dredge residuals and operational BMPs are used during dredging.</p>	A thin layer sand cap will be placed over dredge residuals promptly after the design dredge elevation has been met in greater than or equal to 95% of the dredging work area. This should significantly limit the mass of contaminant releases to the water column, greatly decreasing short term chemical impacts from remediation activities.	The cost of sand capping materials and placement will increase costs of controlling releases.	A post-dredge six inch sand cap was incorporated for dredging remediation alternatives. The FS assumes that this sand cap combined with BMPs will prevent water quality criteria exceedances.

Table O-1.
Feasibility Study Considerations for Dredge Releases
 Portland Harbor Superfund Site
 Portland, Oregon

Factor	Technical Consideration	Short Term Effectiveness Implication	Cost Implication	FS Evaluation
Duration of Contaminant Release	Releases will occur during and after dredging operations as a result of dissolved and particle-bound contaminants being released to the water column.	The duration of contaminant releases varies depending upon the length of dredging operations and use of release control measures, including thin sand placement.	(not applicable)	Releases were assumed to occur during construction and after construction until placement of a thin sand residuals cap. The FS assumes that this sand cap combined with BMPs will prevent water quality criteria exceedances.
Water Depth	Increased water depth will limit the implementability of engineered control measures. The use of engineered controls within the navigation channel is generally considered non-implementable due to water depth and navigation requirements.	Increased water depth will reduce the effectiveness of silt curtains, and will preclude the use of sheet piles and silt curtains beyond a certain water depth. This will result in increased contaminant releases to areas downstream of the work area.	Increased water depth will require additional materials, design considerations, and installation/maintenance costs for engineered control measures. All of these factors will increase control costs.	Neither rigid control measures nor silt curtains were considered feasible in water depths greater than 50 feet for this site. Rigid control measures (for NAPL areas) or silt curtains were assumed to be used in areas outside of the navigation channel with water depths less than 50 feet for this site.

Table O-1.
Feasibility Study Considerations for Dredge Releases

Portland Harbor Superfund Site

Portland, Oregon

Factor	Technical Consideration	Short Term Effectiveness Implication	Cost Implication	FS Evaluation
Water Current	Dredging in areas of high water current may increase release rates due to sediment erosion/re-suspension and downstream transport.	High water current (greater than 2.5 feet per second) may limit the implementability and effectiveness of silt curtain controls, thereby increasing contaminant release rates/mass.	(not applicable)	Dredging was assumed to take place during the approved in-water work window when river currents are expected to be low and the use of silt curtains is considered feasible.

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